**NEV files**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Animal/Prep** | **Filename** | **Bias** | **Presentation duration** | **Notes** |
| Cadet (awake) | Cadetv1p366 | 2:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p371 | 2:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p392 | 2:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p419 | 2:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p438 | 2:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p467 | 2:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p384 | 6:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p385 | 6:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p403 | 6:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p432 | 6:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p437 | 6:1 | 150ms | Not included in analyses bc kernel looks weird |
|  | Cadetv1p460 | 6:1 | 150ms | 20° steps – 9 stim |
|  | Cadetv1p468 | 6:1 | 150ms | 20° steps – 9 stim |
| Anesthetized | 142l001p009 | 6:1 | 150ms | 10° ori steps |
|  | 142l001p004 | 6:1 | 150ms | 10° ori steps |
|  | 141r001p038 | 6:1 | 150ms | 10° ori steps |
|  | 141r001p027 | 6:1 | 150ms | 10° ori steps |
|  | 141r001p009 | 6:1 | 150ms | 10° ori steps |
|  | 141r001p007 | 6:1 | 150ms | 20° steps – 9 stim |
|  | 141r001p025 | 6:1 | 150ms | 20° steps – 9 stim |
|  | 141r001p039 | 6:1 | 150ms | 20° steps – 9 stim |
|  | 142l001p006 | 6:1 | 150ms | 20° steps – 9 stim |
|  | 142l001p010 | 6:1 | 150ms | 20° steps – 9 stim |
|  | 140l001p113 | 4:1 | 150ms | 20° steps – 9 stim |
|  | 141r001p106 | 4:1 | 150ms | 20° steps – 9 stim |
|  | 141r001p024 | 4:1 | 150ms | 20° steps – 9 stim |
|  | 141r001p041 | 4:1 | 150ms | 20° steps – 9 stim |
|  | 142l001p002 | 4:1 | 150ms | 20° steps – 9 stim |
|  | 142l001p007 | 4:1 | 150ms | 20° steps – 9 stim |
|  | 130l001p170 | 4:1 | 70ms | 20° steps – 9 stim |
|  | 140l001p108 | 4:1 | 70ms | 20° steps – 9 stim |
|  | 140l001p110 | 4:1 | 70ms | 20° steps – 9 stim |
|  | 140r001p107 | 4:1 | 70ms | 20° steps – 9 stim |
|  | 140r001p109 | 4:1 | 70ms | 20° steps – 9 stim |
|  | 141r001p114 | 4:1 | 70ms | 20° steps – 9 stim |
|  | 140r001p122 | 2:1 | 70ms | 20° steps – 9 stim |
|  | 140r001p105 | 2:1 | 70ms | 20° steps – 9 stim |
|  | 140l001p122 | 2:1 | 70ms | 20° steps – 9 stim |
|  | 140l001p107 | 2:1 | 70ms | 20° steps – 9 stim |
|  | 130l001p169 | 2:1 | 70ms | 20° steps – 9 stim |
|  | 129r001p173 | 2:1 | 70ms | 20° steps – 9 stim |
|  | 140r001p115 | 4:1 | 70ms | Low contrast |
|  | 140r001p116 | 4:1 | 70ms | Low contrast |
|  | 140l001p114 | 4:1 | 70ms | Low contrast |
|  | 140l001p117 | 4:1 | 70ms | Low contrast |
|  |  |  | 35ms | As similar to benucci 2013 paper paradigm as I could make it |
|  | Benucci |  |  |
|  | \_oricon |  |  |  |
|  |  |  |  |  |
|  |  |  |  | Combination of contrasts and orientations X x X |

*Expo XML files accompany each nev file (those of the same experiment are identical)*

* *Awake file names end in \*[benucciX] where X is the bias ratio (e.g. 2 = 2:1; 4=4:1; etc)*
* *Acute file names end in \*[ensunbiasX] where X is the bias ratio. Some files names also include descriptors like \*awaketime\* or \*fineori\* to indicate additional stimulus parameters.*

**Description of experiment and purpose**

Using the experimental paradigm of Benucci et al 2013 (uniform and biased stimulus distribution with 9 orientations evenly spaced 20° apart). We tested the effects of adaptation in the biased distribution on stimulus decoding (LDA), mutual information, and response correlations.

**Analysis and Figure code**

Ensumbias\_preprocess – reads in nev and expo data. Chops up responses for stim/trials

Ensumbias2 – loads preprocess data and calculates responsivity and tuning. Identifies optimal response latency.

LatencyPlot – plots optimal response latency (Smith 2005 for methods) for each unit, each file separately.

GainFits\_IndivFiles – fits one-gain-fit and two-gain-fit to each data file separately (all files are fit together in Acute/Awake\_combined.

Benucci\_corr – response, signal, and noise correlations. Covariance. Shuffled correlations. Plots for individual files. Awake and acute.

Benucci\_LDA – runs LDA decoder on individual files (awake and acute). Different versions of LDA: 1) all trials/stim; 2) 3-stim comparison w/ all units; 3) neurometric (different population sizes); 4) different #s of trials – sanity check for power.

Adam\_decode\_lda – pretty much the same as Benucci\_LDA

Amir\_reproduce – Amir’s pass at reproducing Adam’s decoding result (Adam\_decode\_lda). Updated version in benucci\_lda

Benucci\_GLM – runs GLM decoder on individual files (awake and acute) as a complement to the lda.

Data\_benucci\_MI – calculates mutual information over all trials and subsampled trials for each unit. Anesthetized.

MI\_dissect – plots mutual information as a function of orientation preference. Creates plot with different tuning requirements.

stimMI – figures for “mutual information” in stimulus domain (rather than neuron domain). Ultimately decided not to use this metric.

Hcorrection – function: corrects for bias in measuring response entropy. Method described in Vinje and Gallant 2002 (eq 10)

Acute\_combined – combines across all files for each of the core analyses: decoding, correlations, responsivity/gain, mutual information.

Ak\_data\_benucci – adam’s first pass on preprocessing data and looking at Benucci 2013 metrics.

FigureCode – makes figures (see below)

Acute\_droptrials\_preprocess – drops first 30s trials after each ‘switch’ to focus on adapted responses.

-----------------------------Awake

Benucci\_awake – preprocesses awake data. Load nev and expo. Chop up response epochs. Calculate tuning and fano.

Awake\_combined – combines across all files for each of the core analyses: decoding, correlations, responsivity/gain, mutual information.

Data\_benucci\_MI\_awake - calculates mutual information over all trials and subsampled trials for each unit. awake.

Data\_MIjoint\_awake – calculates mutual information on pairwise responses.

Awake\_droptrials\_preprocess – drops first X trials after switch from uniform to bias distribution.

Lda\_pseudopop\_awake\_acute\_matchOSI – final version of linear decoder. Combined units across all recordings and randomly sampled from awake pseudo-population and anesthetized pseudo-population to create distributions matched to their tuning selectivity. Same number of units were used to train a decoder for each pseudopopulation to compare how tuning effects decoder performance.

---------------------------------Model related

TCmodel\_responses – function: returns tuning curves and responses for synethetic populations of 5 models: pre-adapt, ssa, neuron-gain, Full, and each half of full alone.

One\_gain\_fit – function: uses least squares to find parameters of ssa and neuron-gain model. Returns lsq error.

Two\_gain\_fit – function: same as one\_gain\_fit for the Full model.

Model\_schematic – shows how Weibull function changes with each parameter, assuming other parameters held fixed. Produces plot to visualize changes. Didn’t use parameters of Weibull as summary statistic.

DecodeSim – most up-to-date version of decoding analysis for simulation.

Benucci\_sim\_aa – first pass at simulation of core analyses for models.

Benucci\_sim\_aa2 – more up-to-date simulation of core analyses for models.

Sim\_match2data – loads an awake data file and parametrizes tuning curves of each unit using von mises max likelihood. Then it creates a synthetic population of neurons using those tuning parameters and simulates the decoding analysis.

Lda\_pnf\_fit – function: fits Weibull function to decoding neurometric data using max likelihood.

AUROC – calls lda pnf data and calculates area under receiver operating characteristic. Ultimately, didn’t use this metric because of its similarity to area under lda pnf.

General/other

Nev\_reader – reads spiking data to matlab.

ReadExpoXML – reads expo data to matlab.

**Matlab Worksheets (mostly correspond to analyses listed above)**

<p-file name>\_preprocess -

\*\_corr – response, signal and noise correlations of individual files

\*\_entropy – entropy, conditional entropy, and mutual information of individual files

\*\_jentropy – joint entropy (pairwise responses) and synergy of individual files

\*\_lda\_pnf

Acute\_combined\_\*: creates worksheets for each of the above mentioned analyses and aggregates results across individual files

\*\_Gainfactors – adaptation gain parameters and kernels (see benucci 2013 figure 4)

\*\_Lda - decoder

\*\_MUMI – multi-unit mutual information (pairwise)

\*\_Responsivity – tuning and response metrics

\*\_SNR – signal to noise

\*\_SUMI – single-unit mutual information.

--------------------------------model worksheets:

GainModel\_corr\_diff\_newBW – difference in correlations

GainModels\_corr\_newBW - correlations

GainModels\_MI\_newBW – mutual information

GainModels\_Decode\_3class\_fix2 - decoder

SUMI\_dissect – single unit mutual information

GainModels\_MImatched – MI matched to awake unit metrics

GainModels\_MIacute – MI with adapt kernels from acute data

**Figures (pdfs)** Current, but not finalized (i.e. ready for submission)

Figure 1 - **Stim\_protocol** – stimuli and adaptation paradigm (awake and anesthetized)

Figure 2 – **Awake\_AdaptationGain3.3** – Response matrices and model fits

Figure 3 – **decode\_data\_andmodel5** – example decoding sessions and average performance (awake and anesthetized). Same for model simulations

Figure 4 – **Correlation\_data\_and\_model\_3** – response, signal, and noise correlations (awake and anesthetized). Model signal correlations.

Figure 5 – **MI\_results3** – single-unit MI, MI/spike, joint MI, Synergy for awake, anesthetized, and model.